THE DRY AIR CENTERED AROUND NASHVILLE, TENN., JULY 22, 23, 24, 1952

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INTRODUCTION

Unusually low surface dew points were observed over a wide area centered around Nashville, Tenn., July 22, 23, and 24, 1952. This dry air can be traced, at the 850-mb. level, from Nantucket, Mass., to Bermuda, thence to Miami, Fla., and into the Gulf of Mexico where it curved northwestward to the coast of east Texas and Louisiana. From here it moved over Little Rock, Ark., finally appeared at the surface in the Nashville, Tenn. area, and spread over a large section of the southeastern States.

This dry air apparently contributed to the severity and prolongation of the drought suffered in the southeastern United States during the month of July,[1] for arrival of the dry air in this area precluded any extensive convective activity under synoptic circumstances where warm, moist, tropical air from the Gulf and accompanying widespread showers normally would have been expected. It is the purpose of this article to outline briefly the movement of the dry air and its spread over the surface.

MOVEMENT OF THE DRY AIR

Dry air, at the 850-mb. level, was observed over Nantucket, Mass. July 14, 1952 (fig. 1). A parcel of this air was traced downstream from July 14 to 23 using 850-mb. mean winds (fig. 2).[2] The dry air was first advected toward Bermuda, arriving there July 16 (fig. 3). From Bermuda the dry current flowed around the periphery of a high pressure cell, which on July 16 was centered (at the 850-mb. level) between the Atlantic coast line and Bermuda (33° N., 70° W.). This high pressure cell

[1] For a more detailed account of the drought in the southeastern United States and the mean flow for July, see the adjacent article by Klein [1].

[2] The trajectory was constructed by estimating an average wind speed and direction from a comparison of the wind flow at 850-mb. before and after the time of plot. The parcel was then moved ahead to the point given by this average wind and the procedure repeated for each new position.

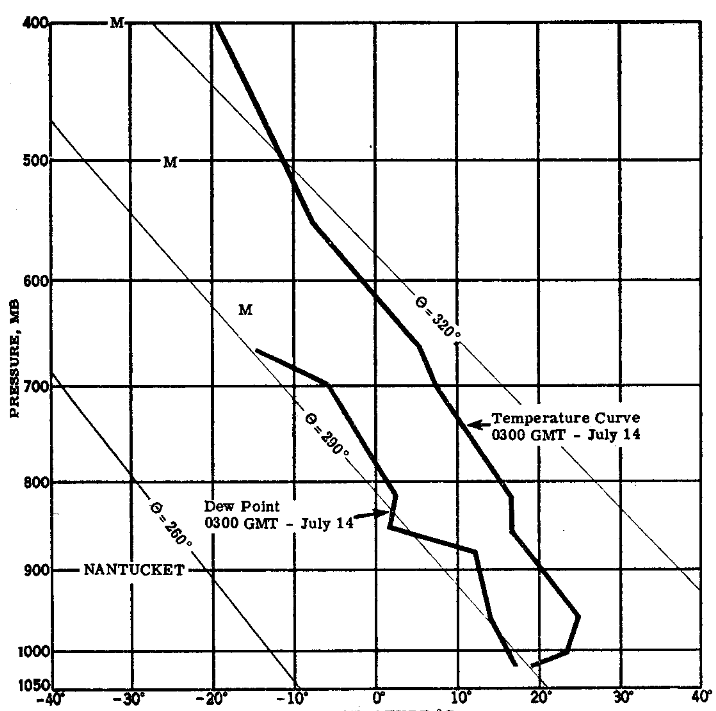

FIGURE 1.—Upper air sounding over Nantucket, Mass., 0300 GMT, July 14, 1952. "M" on the dew point curve indicates missing data due to "motorboating" (failure of the radiosonde instrument to record accurately due to the low moisture content of the air).

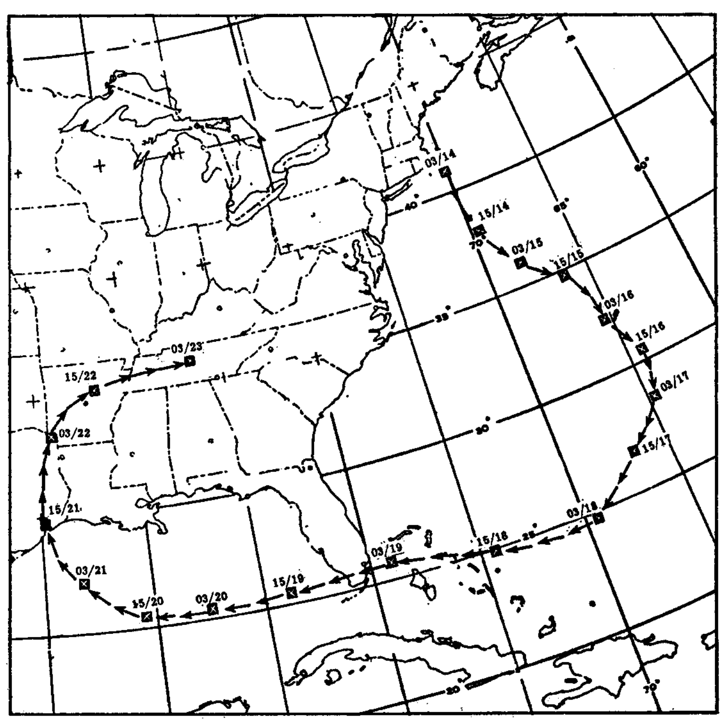

FIGURE 2.—850-mb. level mean wind trajectory of the dry air, July 14–23, 1952. Positions are for 12-hour movements at 0300 GMT and 1500 GMT to coincide with times of upper air soundings. Plotted number groups indicate time and date (TIME/DATE) of positions.

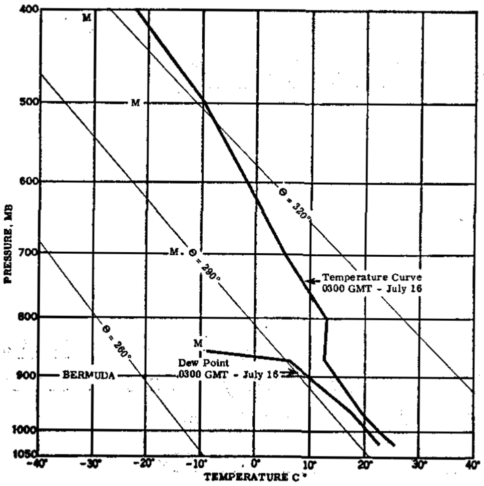

FIGURE 3.—Upper air sounding over Bermuda, 0300 GMT, July 16, 1952.

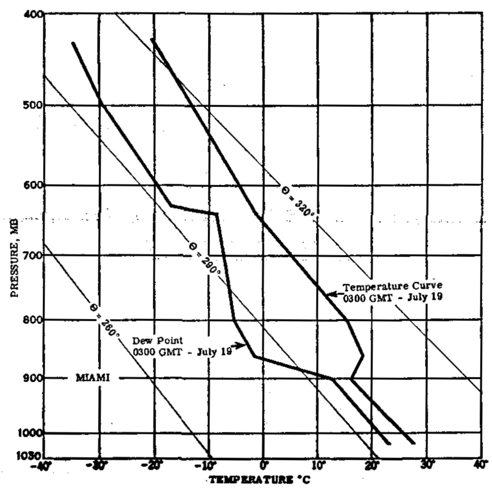

FIGURE 4.—Upper air sounding over Miami, Fla., 0300 GMT, July 19, 1952.

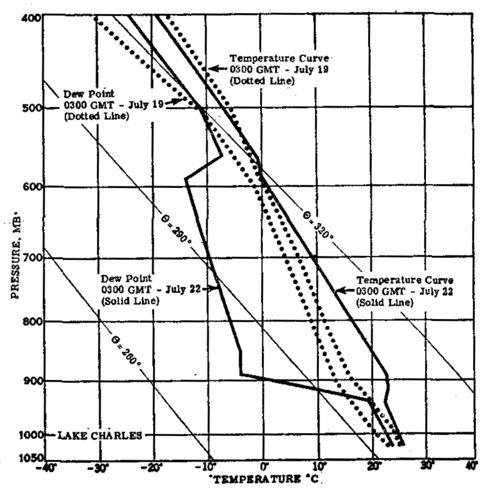

FIGURE 5.—Upper air sounding over Lake Charles, La., 0300 GMT, July 19 and 22, 1952.

drifted slowly to the west and was centered inland, just to the northwest of Jacksonville, Fla. July 19, when the dry air reached Miami, Fla. (fig. 4).

The path of the parcel of dry air from Bermuda to Miami was markedly more anticyclonic than a constant vorticity trajectory. It follows, therefore, from the well known theory for the individual change of absolute vertical vorticity that divergence was present in the lower layers with air sinking from aloft. This subsidence resulted in lowering the base of the dry layer as it passed from Bermuda to Miami (figs. 3 and 4). The base of the subsidence layer at Bermuda (fig. 3) was at 870 mb. with a potential temperature of 297° A, while at Miami (fig. 4) the base of the inversion was at 900 mb. and had a potential temperature of 298° A. The steep lapse rate from 800 mb. to 650 mb. at Miami is characteristic of subsiding air [2]. As the individual parcels of air sank isentropically to higher pressures, it may be assumed that their horizontal path was adequately represented by the 850-mb. trajectory, for although the 850-mb. surface was not a true isentropic surface, the temperature gradient was extremely flat in the area over which the dry air traversed. From this one may infer that the subsidence was associated with isentropic lateral divergence [3].

From Miami the dry current curved across the Gulf of Mexico, crossed the Texas-Louisiana coast west of Lake Charles (figs. 5 and 6), moved over Little Rock, Ark. (figs. 7 and 8), and finally appeared at the surface in the area centered around Nashville, Tenn. (figs. 9 and 10). The figures 5, 7, and 9 show the soundings for Lake Charles, Little Rock, and Nashville for times at which the dry air was over the stations. The soundings for July 19, 1952, are also shown to indicate the extent to which the air had dried.

THE DRY AIR AT THE SURFACE

After the dry air made its appearance at the surface it spread over a large section of the southeastern States. The region in which low surface dew points were observed extended from Little Rock over northern Louisiana, and covered the entire States of Tennessee and Kentucky and most of Alabama except for the Gulf coastal area, the northern half of Georgia, the northwestern part of South Carolina, and extreme western North Carolina. Table 1 shows that the lowest dew points were observed between 1830 GMT and 0330 GMT July 22–23, and July 23–24. The lowest dew points coincide with the periods of maximum temperatures. Turbulent mixing bringing the dry air down from aloft can account for the lowest dew points being observed during the warmest part of the day.

The surface charts for 0030 GMT, July 22, 23, and 24 (figs. 11, 12, and 13) show a cold front from the north-northwest approaching the area that was affected by the dry air. Temperatures and dew points are shown at selected stations on the charts both in the air in advance of the cold front and in the air behind. The surface dew points in the southeastern States on July 22, 1952 (fig. 11) are near normal for this type of synoptic situation and for this season. Reports for Nashville, Tenn. and for some stations in Arkansas, Louisiana, and Alabama indicate that the dry air was beginning to move in aloft with turbulent mixing lowering the surface dew points to some extent at this time. On July 23 and 24, at 0030 GMT (figs. 12 and 13), the dry air was at or near the surface in the southeastern States. The driest air in the area, which was centered around Nashville, was as dry as the air behind the approaching cold front. The cold front passed through the northern sector of the dry area July 24, with the stations reporting only clear to scattered sky coverage.

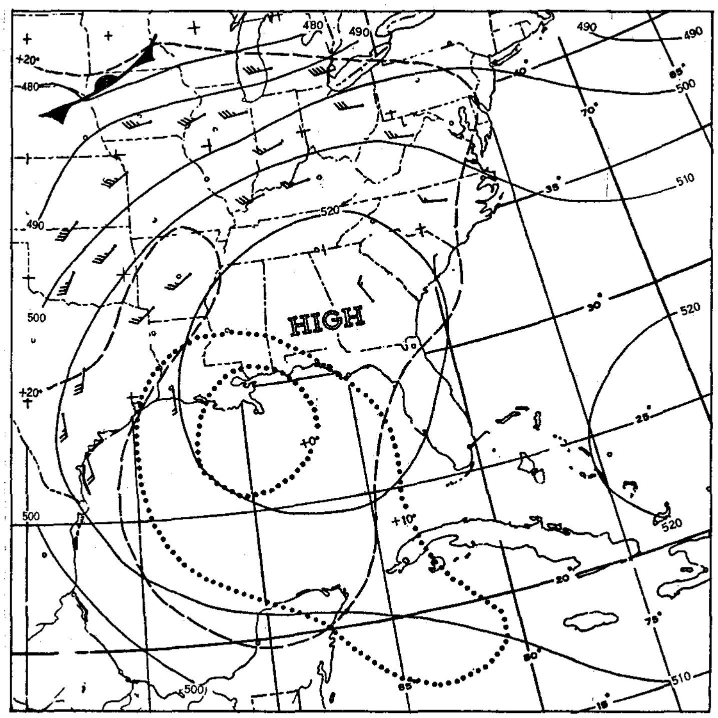

FIGURE 6.—850-mb. chart for 0300 GMT, July 21, 1952. Contours (solid lines) at 100-ft. intervals are labeled in hundreds of geopotential feet. Isotherms (dashed lines) at intervals of 5° C. Isograms of dew point temperature (dotted lines) at intervals of 10° C. Barbs on wind shafts are for wind speeds in knots; full barb for every 10 knots and half barb for 5 knots.

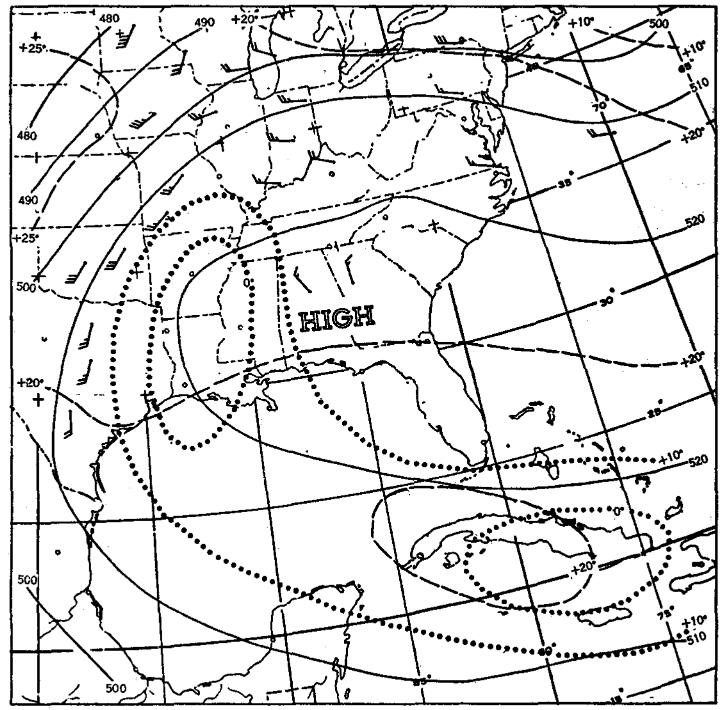

FIGURE 8.—850-mb. chart for 0300 GMT, July 22, 1952.

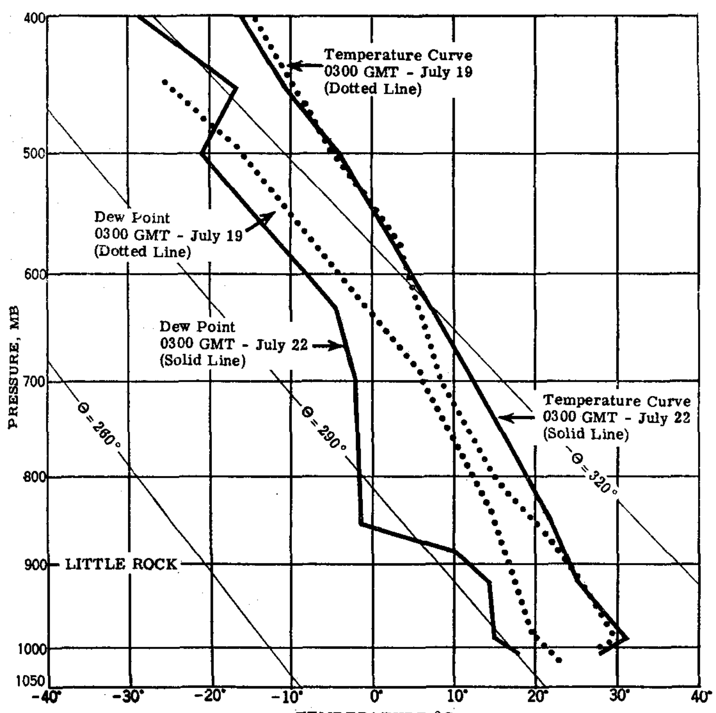

FIGURE 7.—Upper air soundings over Little Rock, Ark., 0300 GMT, July 19 and 22, 1952.

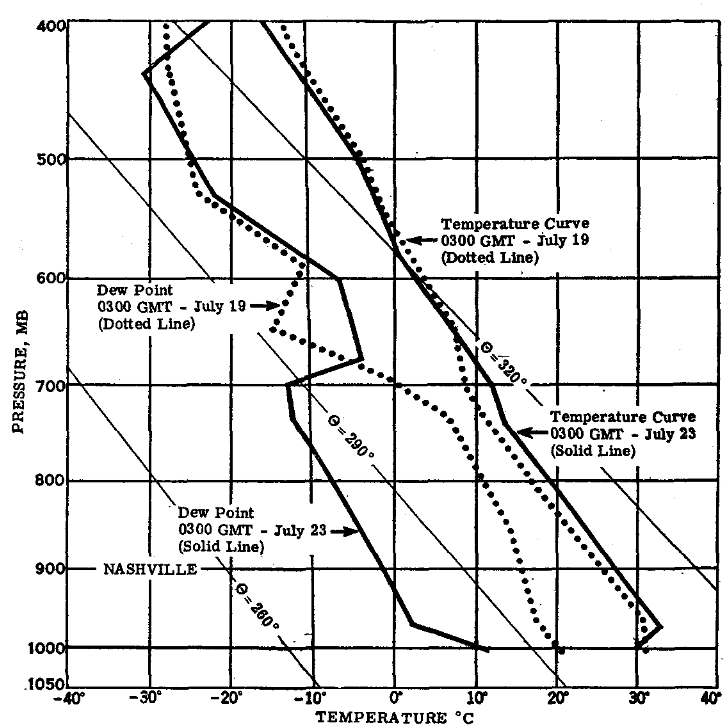

FIGURE 9.—Upper air soundings over Nashville, Tenn., 0300 GMT, July 19 and 23, 1952.

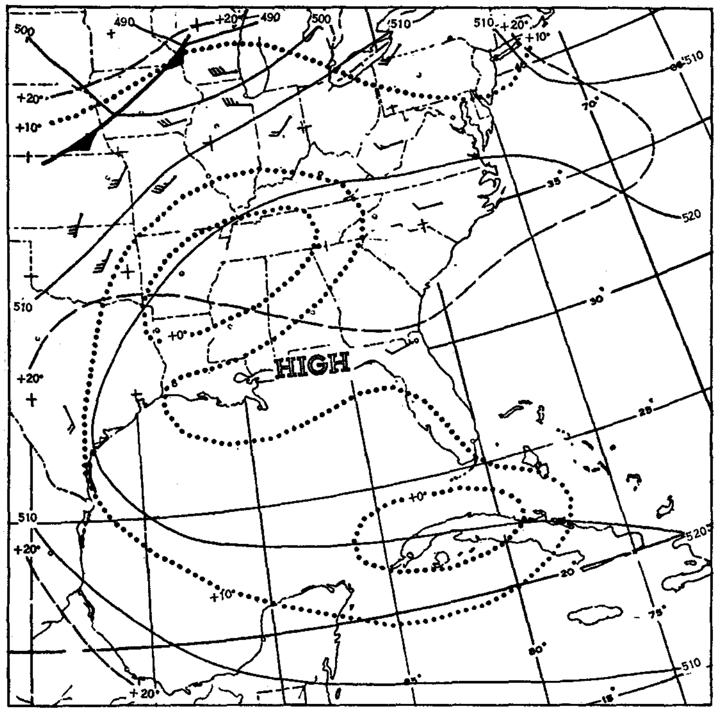

FIGURE 10.—850-mb. chart for 0300 GMT, July 23, 1952.

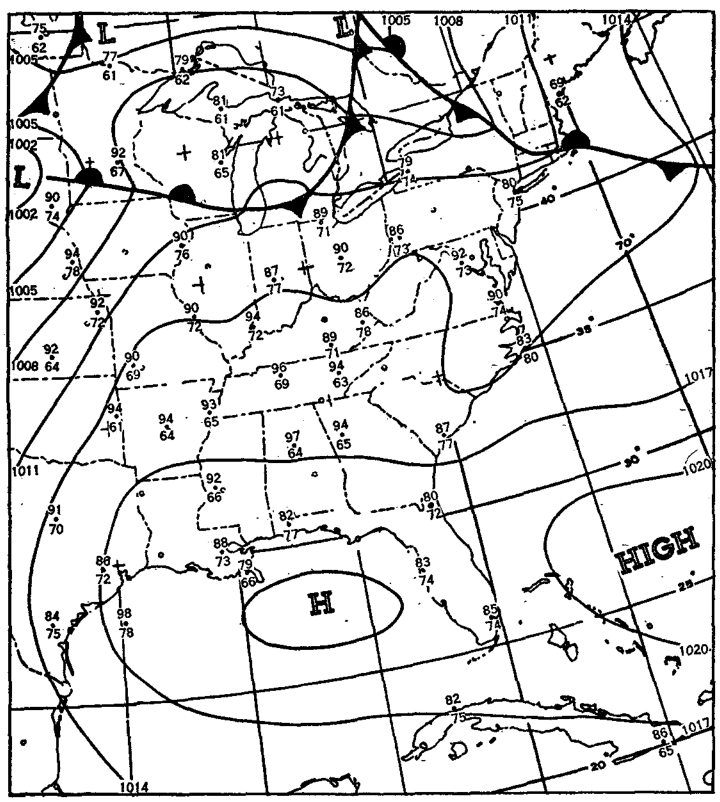

FIGURE 11.—Surface weather map for 0030 GMT, July 22, 1952. Plotted numbers at station circles indicate observed temperatures and dew points at the map time.

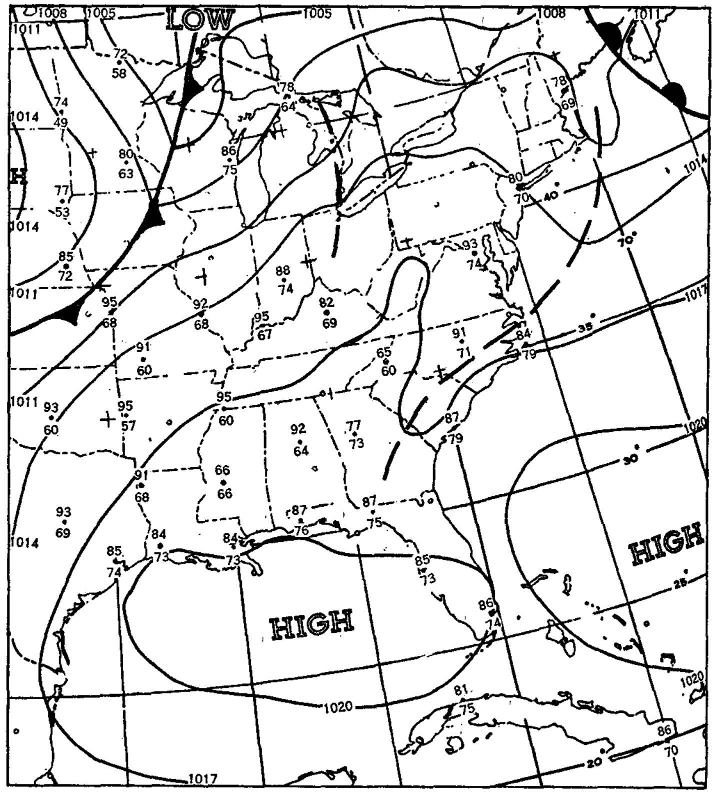

FIGURE 12.—Surface weather map for 0030 GMT, July 23, 1952.

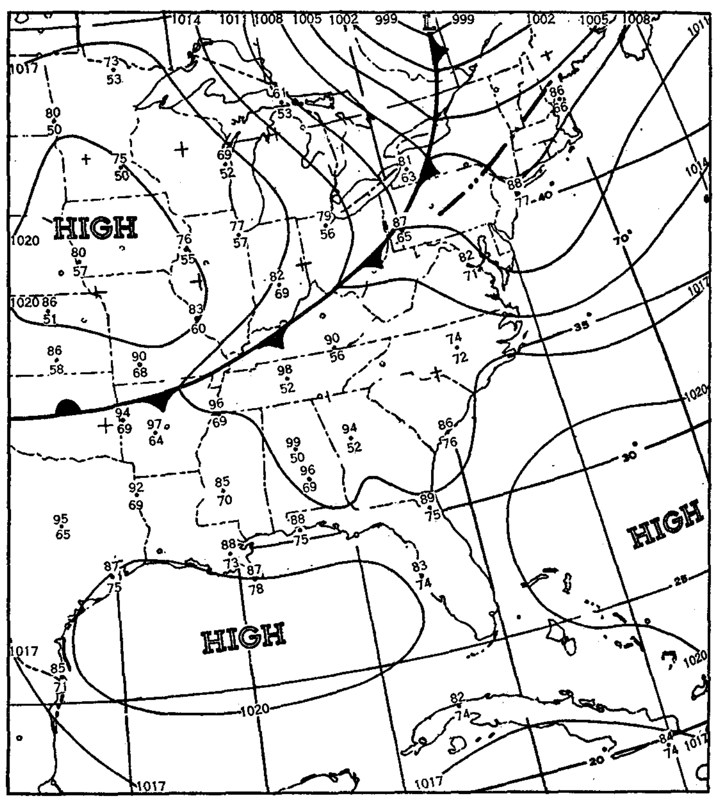

FIGURE 13.—Surface weather map for 0030 GMT, July 24, 1952.

TABLE 1.—*Some three-hourly temperature (° F.) and dew point (° F.) observations, July 22–24, 1952*

Date and time	Little Rock, Ark.		Memphis, Tenn.		Muscle Shoals, Ala.		Nashville, Tenn.		Knoxville, Tenn.		Lexington, Ky.	
	Temperature	Dew point	Temperature	Dew point	Temperature	Dew point	Temperature	Dew point	Temperature	Dew point	Temperature	Dew point
July 22:												
1530 GMT	87	70	89	70	92	63	93	68	89	69	91	70
1830 GMT	94	61	96	65	99	61	90	63	95	69	96	68
2130 GMT	99	58	100	60	98	51	102	52	100	69	87	70
July 23:												
0030 GMT	95	61	95	60	93	60	97	54	94	67	82	69
0330 GMT	86	60	84	63	83	62	84	54	83	68	78	70
0630 GMT	80	62	77	65	78	61	76	57	79	70	75	69
0930 GMT	72	64	73	64	73	65	74	58	76	69	72	65
1230 GMT	75	66	74	65	74	65	78	62	77	70	77	64
1530 GMT	90	68	90	69	91	62	91	62	90	61	90	61
1830 GMT	97	62	98	61	99	52	100	54	96	60	95	58
2130 GMT	100	62	102	62	102	47	100	53	99	52	98	57
July 24:												
0030 GMT	97	64	96	64	97	51	98	52	95	49	92	65
0330 GMT	87	67	84	62	87	45	86	58	85	56	83	71
0630 GMT	82	68	79	67	-----	-----	81	62	78	53	76	64
0930 GMT	77	-----	75	66	72	59	78	66	73	58	70	58
1230 GMT	79	68	80	70	74	62	80	65	76	59	70	59
1530 GMT	88	70	88	66	90	64	85	62	89	68	78	54
1830 GMT	94	72	95	67	95	68	91	55	93	68	83	54
2130 GMT	-----	-----	99	66	86	73	95	47	96	63	84	51

• Heavy line denotes frontal passage.

There was a brief period of convective activity in the southeastern sector of the dry area late on July 24. After passing through the northern sector of the dry area, the front slowed and weakened. Frontolysis set in late on July 25.

Normally, we would have expected warm, moist, tropical air moving up from the Gulf of Mexico into the region in advance of the approaching cold front. The dryness and stability of the air which came up from the Gulf, however, precluded any extensive convective activity in the frontal zone, resulting in little or no precipitation as the front moved through the drought area. It is also interesting to note that record to near-record maximum temperatures were recorded at many stations throughout the dry area for an 8- to 10-day period which began with this situation.

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REFERENCES

1. William H. Klein, "The Weather and Circulation of July 1952," *Monthly Weather Review*, vol. 80, No. 7, July 1952, pp. 118–122.
2. S. Petterssen, P. A. Sheppard, C. H. B. Priestley and K. R. Johannessen, "An Investigation of Subsidence in the Free Atmosphere," *Quarterly Journal of the Royal Meteorological Society*, vol. 73, Nos. 315–316, January-April 1947, pp. 43–64.
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